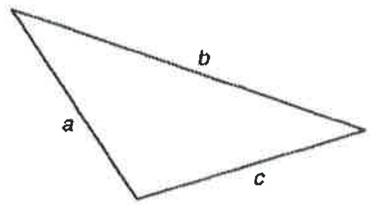
Geometry H
7.2: Converse of Pythagorean Theorem

Name: Key
Date: ____________ Period: ________

Today's Learning Targets:

- I can determine if side lengths form a triangle.
- I can find possible side lengths of a triangle
- I can classify a triangle as acute, obtuse, or right given side lengths.

Theorem	**Example**
Triangle Inequality Theorem The sum of any two sides of a triangle is greater than the third side length.	 $a+b>c$ $b+c>a$ $c+a>b$

Example 1: *Find possible side lengths.*

The lengths of two sides of a triangle are given. Describe the possible lengths of the third side.

a) 14 and 10 (a, b)

$a+b>c$ | $b+c>a$ | $c+a>b$
$14+10>c$ | $10+c>14$ | $c+14>10$
$24>c$ | $c>4$ | $c>-4$ ← doesn't work; can't have negative side lengths

$4<c<24$

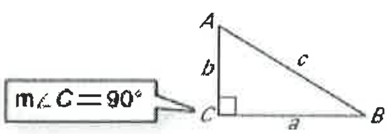
b) 23 and 17 (a, b)

$a+b>c$ | $b+c>a$ | ~~$c+a>b$~~
$23+17>c$ | $17+c>23$ | ~~$c+23>17$~~
$40>c$ | $c>6$ | ~~$c>-6$~~ ← doesn't work

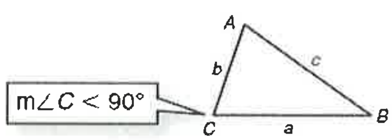
$6<c<40$

Converse of Pythagorean Theorem

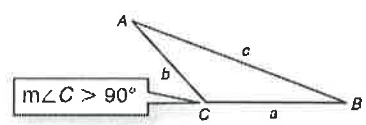
Given three sides of a triangle, *a*, *b*, and *c*, where *c* is the longest side, if $c^2=a^2+b^2$, then the triangle is a right triangle.



Given three sides of a triangle, *a*, *b*, and *c*, where *c* is the longest side, if $c^2<a^2+b^2$, then the triangle is an acute triangle.



Given three sides of a triangle, *a*, *b*, and *c*, where *c* is the longest side, if $c^2>a^2+b^2$, then the triangle is an obtuse triangle.



Example 2: *Classify triangles, if possible.*

Determine if the given side lengths can form a triangle. If so, would the triangle be acute, right, or obtuse?

a) 4, 7, 9 (a, b, c)

Is it a triangle?
$4+7>9$ ✓
$4+9>7$ ✓
$7+9>4$ ✓
Yes

$c^2 \_ a^2+b^2$
$9^2 \_ 4^2+7^2$
$81 \_ 16+49$
$81 > 65$
$c^2>a^2+b^2$
obtuse △

b) 10, 13, 16 (a, b, c)

triangle?
$10+13>16$ ✓
$10+16>13$ ✓
$13+16>10$ ✓
Yes

$c^2 \_ a^2+b^2$
$256 \_ 10^2+13^2$
$256 \_ 100+169$
$256 < 269$
$c^2<a^2+b^2$
acute △

c) 5, 14, 20 (a, b, c)

triangle?
$5+14>20$ ✗
Not a △

d) $3, 5, \sqrt{34}$ (a, b, c) ≈ 5.8

triangle?
$3+5>5.8$ ✓
$5+5.8>3$ ✓
$3+5.8>5$ ✓
Yes

$c^2 \_ a^2+b^2$
$(\sqrt{34})^2 \_ 3^2+5^2$
$34 \_ 9+25$
$34=34$
right △

Example 3: Creating triangles

An obtuse triangle has side lengths x, x-3, and 33, where 33 is the length of the longest side. What value(s) of x make the triangle obtuse?

What value(s) of x make the lengths form a triangle?

$x + x - 3 > 33$

$2x - 3 > 33$

$2x > 36$

$x > 18$

~~$x + 33 > x - 3$~~

~~$33 > -3$~~

~~$x - 3 + 33 > x$~~

~~$x + 30 > x$~~

~~$30 > 0$~~

What value(s) make the triangle obtuse?

$c^2 > a^2 + b^2$

$33^2 > x^2 + (x-3)^2$

$1089 > x^2 + (x-3)(x-3)$

$1089 > x^2 + x^2 - 6x + 9$

$1089 > 2x^2 - 6x + 9$

$0 > 2x^2 - 6x - 1080$

$\frac{0}{2} > \frac{2(x^2 - 3x - 540)}{2}$

$0 > x^2 - 3x - 540$

$0 > (x - 24.7)$

$24.7 > x$

$\frac{3 \pm \sqrt{(-3)^2 - 4(1)(-540)}}{2} = \frac{3 \pm \sqrt{2160}}{2}$ → 24.7, ~~-21.7~~

↑ can't have negative side lengths

So $18 < x < 24.7$